

**Connecting Cognitive Science
and Measurement Science:
An Argument Regarding
Necessity & Sufficiency**

Jim Pellegrino



University of Illinois at Chicago
Learning Sciences Research Institute



The Gist of My Argument Today

Learning Sciences Research Institute
University of Illinois at Chicago

- The Gordon Commission vision for the future of assessment is both bold and appropriate
- Attainment of that vision demands integration of the cognitive and measurement sciences.
 - This is not a new issue – “déjà vu all over again”
- We are better poised now to meet the challenges than was previously the case.
- The time is now to shape the future of educational assessment

The Gordon Commission Final Report



To Assess, To Teach, To Learn: A Vision for the Future of Assessment

Technical Report



The Gordon Commission
on the Future of Assessment in Education



A Public Policy Statement



The Gordon Commission
on the Future of Assessment in Education

We Must Reconsider Why, What and How we Assess

- **Why? Purpose:** Assessments have different purposes. The main purpose should be to inform, improve and model teaching and learning.
- **What? Skills for life:** Assessments must represent the kind of learning students will need to thrive after graduation and match the era in which they live.
- **How? Systems of examinations:** We must have systems of examinations that include both assessment FOR learning and assessment OF learning.
- **Diversity:** Assessments should be designed with the diversity of the populations that they serve in mind.

**Improving
and reforming
teaching
and learning
through better
assessments**

Assessments Must Support Teaching, Learning and Human Development.

- **Need for change:** Educators, Parents, students, assessment developers and policy makers must understand the need for change.
- **Show student progress:** The best assessments can accelerate the acquisition of competencies if they enable students to gauge their progress.
- **Inform teachers:** Assessments must provide teachers with actionable information about their students and practice in real time.
- **Policy action:** Policy makers must demand assessment systems be robust enough to drive the instructional challenges required to meet the desired educational outcomes.

Improvement of Assessments require actions at the State, Federal and National Levels

- Create a permanent Council on Educational Assessments
- Continue to improve state and consortia assessments
- Reauthorize significant pending legislation (ESEA, DEA, HEA)
- Incentivize states and assessment companies to experiment with radical new approaches to assessments
- USDOE, DOD, NSF, others should begin a 10-year research project to strengthen and develop new assessment approaches



The Gist of My Argument Today

- The Gordon Commission vision for the future of assessment is both bold and appropriate
- Attainment of that vision demands integration of the cognitive and measurement sciences.
 - This is not a new issue – “déjà vu all over again”
- We are better poised now to meet the challenges than was previously the case.
- The time is now to shape the future of educational assessment



Once Upon a Time: E.L. Thorndike



- Principles of scientific psychology
- Theory of learning
- Subject matter learning
- Mental tests and measurements
- Intelligence



Cronbach's “Two Disciplines Problem”



APA Presidential Address -
Sept. 1957

Described the features of the two disciplines of scientific psychology and the benefits of **re-unification**.

Call for linking theories & research on learning & instruction with the tradition of assessing individual differences in cognitive abilities.



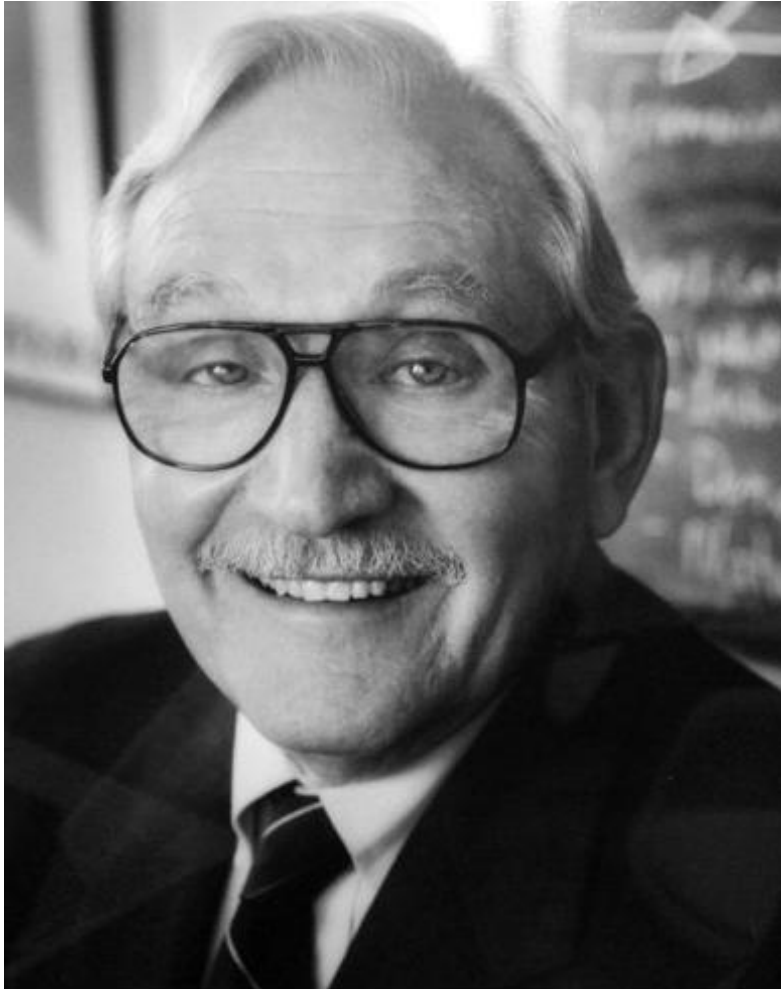
Overly Optimistic Predictions

Learning Sciences Research Institute
University of Illinois at Chicago

- “Such findings...when replicated and explained, will carry us into an educational psychology which measures readiness for different types of teaching and which invents teaching methods to fit different types of readiness.”
- “Constructs originating in differential psychology are now being tied to experimental variables. As a result, the whole theoretical picture in such an area as human abilities is changing.”



A Vision of the Future: Robert Glaser



Essential characteristics of proficient performance have been described in various domains and provide useful indices for assessment. We know that, at specific stages of learning, there exist different integrations of knowledge, different forms of skill, differences in access to knowledge, and differences in the efficiency of performance. These stages can define criteria for test design. We can now propose a set of candidate dimensions along which subject-matter competence can be assessed. (Glaser, 1991)



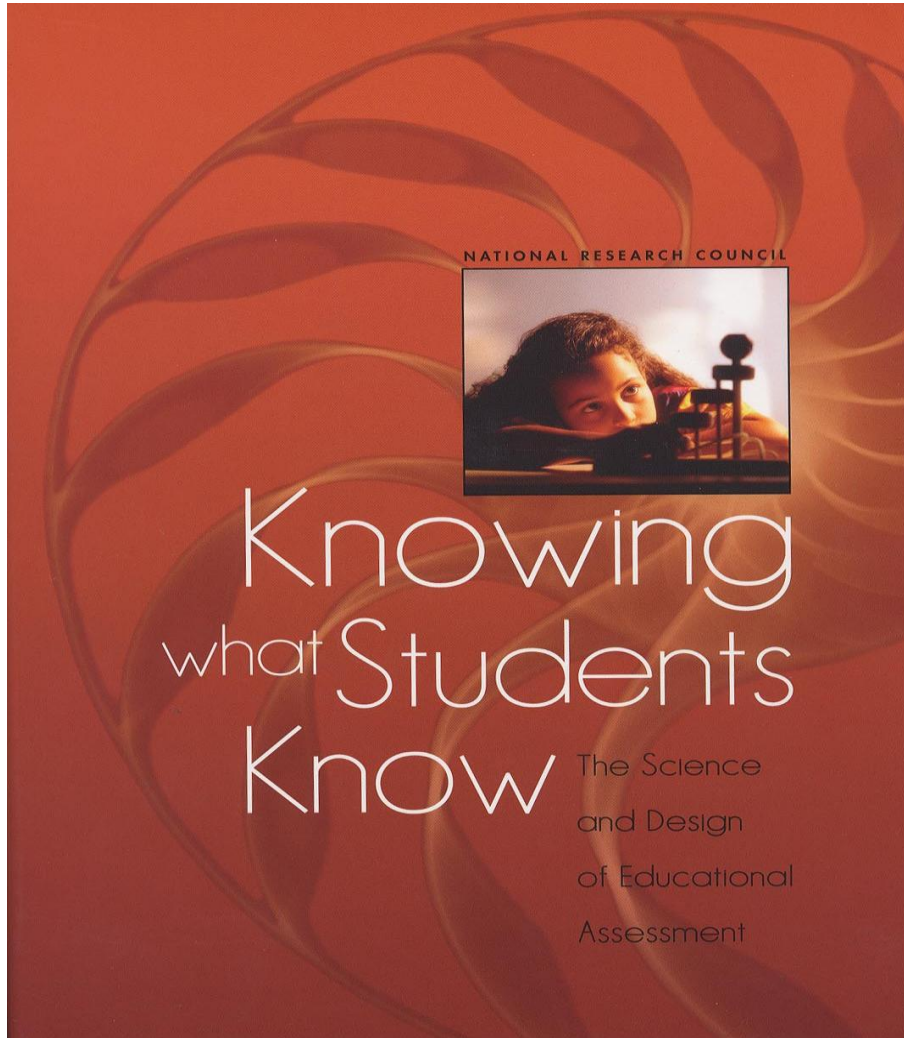
The Gist of My Argument Today

- The Gordon Commission vision for the future of assessment is both bold and appropriate
- Attainment of that vision demands integration of the cognitive and measurement sciences.
 - This is not a new issue – “déjà vu all over again”
- **We are better poised now to meet the challenges than was previously the case.**
- The time is now to shape the future of educational assessment



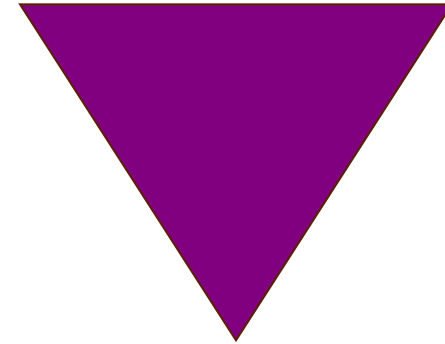
Learning Sciences Research Institute
University of Illinois at Chicago

Assessment as a Process of Reasoning from Evidence



observation

interpretation



cognition

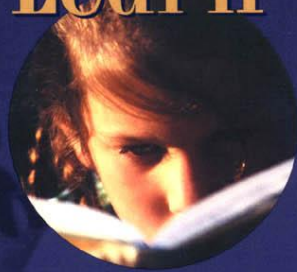
*Must be
coordinated!*



Scientific Foundations of Educational Assessment

- Advances in the Sciences of Thinking and Learning -- **the cognition vertex**
 - informs us about what observations are important and sensible to make
- Contributions of Measurement and Statistical Modeling -- **the interpretation vertex**
 - Informs us about how to make sense of the observations we have made

How People Learn



Brain,



Mind,



Experience,

and

School

NATIONAL RESEARCH COUNCIL

How Students Learn



**HISTORY,
MATHEMATICS,
AND SCIENCE
IN THE
CLASSROOM**

NATIONAL RESEARCH COUNCIL
OF THE NATIONAL ACADEMIES

The logo for the Consortium for Policy Research in Education (CPRE), featuring the letters 'CPRE' in a stylized, serif font.

Consortium for Policy Research in Education



JANUARY 2011

LEARNING TRAJECTORIES IN MATHEMATICS

A Foundation for Standards, Curriculum, Assessment, and Instruction

PREPARED BY

Phil Daro
Frederic A. Moshier
Tom Corcoran

WITH

Jeffrey Barrett
Michael Battista
Douglas Clements

Jess Conroy
Vinod Daro
Alan Maloney

Wakasa Nagakura
Marge Pettit
Julie Sarama

The logo for the Consortium for Policy Research in Education (CPRE), featuring the letters 'CPRE' in a stylized, serif font.

Consortium for Policy Research in Education



May 2009

Learning Progressions in Science

An Evidence-based Approach to Reform

Prepared by

Tom Corcoran
Frederic A. Moshier
Aaron Rogat

Center on Continuous Instructional Improvement
Teachers College—Columbia University



Advances in Measurement & Evidentiary Reasoning

- Types of understanding instead of rankings
- Multiple aspects of proficiency rather than single scores
- Change and growth over time
- Diagnostic indices
- Group differences in cognitive processes & strategies elicited by tasks
- Families of models adaptable to broad range of uses



Connecting Learning Theory & Measurement Theory

- Sophisticated modeling methods are available but in many cases they have yet to be made fully useable and understandable
- At a conceptual level we need to explore the fit between particular statistical models and methods and varying descriptions of competence and learning
 - Models we need vary with the timescale of learning, the “grain size” of analysis, and with the intended purpose and use of the inferences we wish to make
- Dialogue and Collaboration is needed among educators, psychometricians, and learning scientists



The Gist of My Argument Today

- The Gordon Commission vision for the future of assessment is both bold and appropriate
- Attainment of that vision demands integration of the cognitive and measurement sciences.
 - This is not a new issue – “déjà vu all over again”
- We are better poised now to meet the challenges than was previously the case.
- **The time is now to shape the future of educational assessment**

COMMON CORE STATE STANDARDS FOR

Mathematics



A FRAMEWORK FOR K-12 SCIENCE EDUCATION

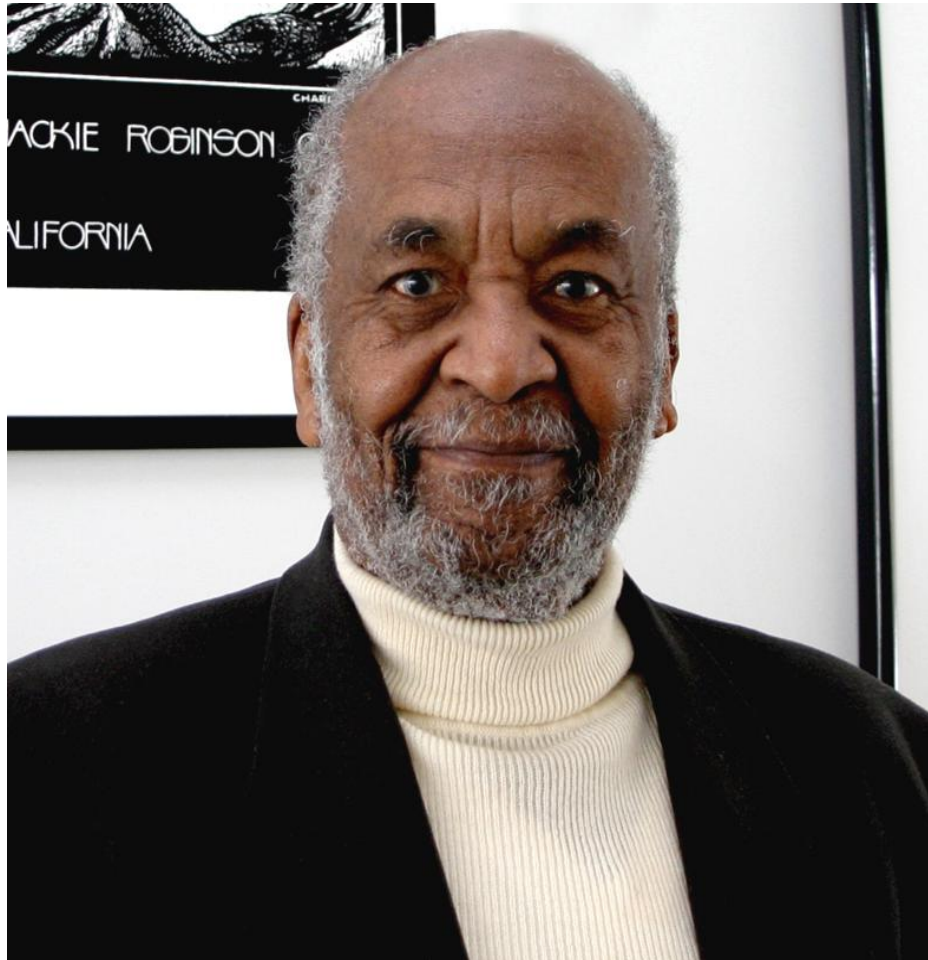
Practices, Crosscutting Concepts, and Core Ideas

NATIONAL RESEARCH COUNCIL
OF THE NATIONAL ACADEMIES





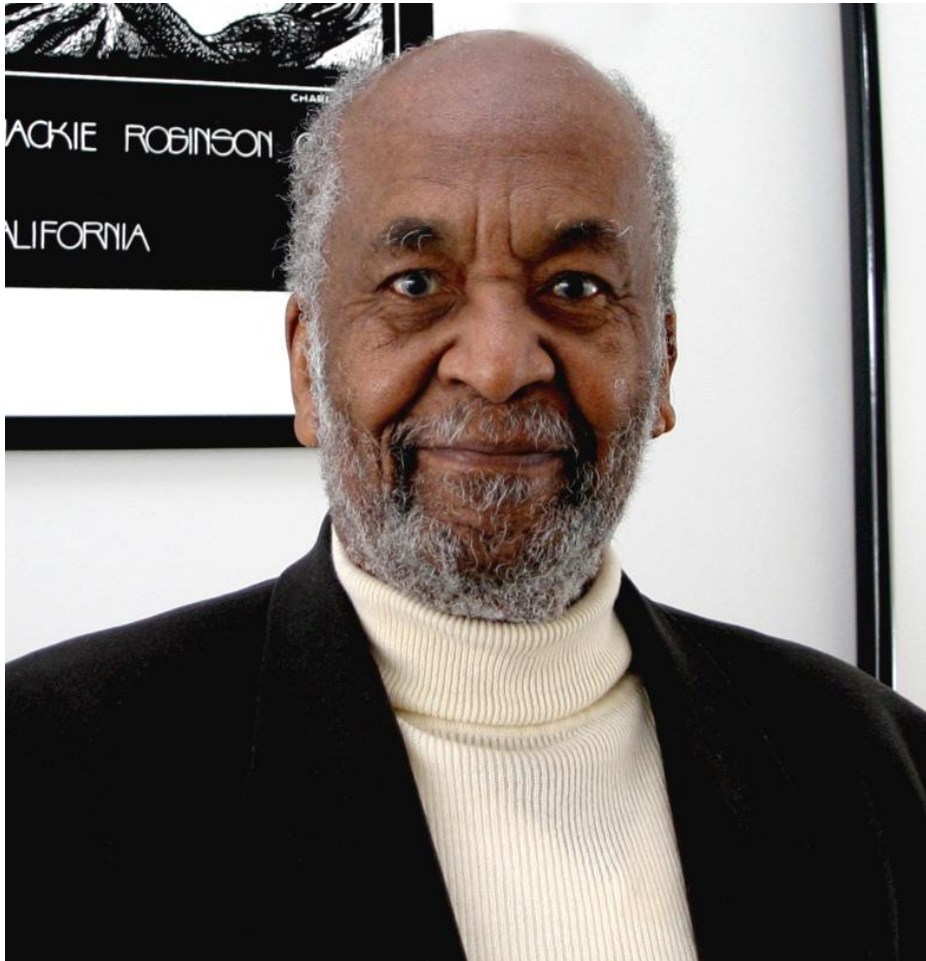
Back to the Future: Edmund Gordon



“To be helpful in achieving the learning goals laid out in the Common Core, assessments must fully represent the competencies that the increasingly complex and changing world demands.... To do so, the tasks and activities in the assessments must be models worthy of the attention and energy of teachers and students.”



Back to the Future: Edmund Gordon



“...it is also important that assessments do more than document what students are capable of and what they know. To be as useful as possible, assessments should provide clues as to why students think the way they do and how they are learning as well as the reasons for their misunderstandings.”